

REMARKS/ARGUMENTS

A Request for Continued Examination and Declaration Under 37 CFR 1.132 is submitted concurrently with the present Amendment and Response to Office Action. Applicants hereby petition for the minimum extension of time necessary such that the present submission is timely filed.

In response to the pending Office Action of December 24, 2008, Applicants present the following arguments and amendments. The present amendments are requested solely for the purpose of more clearly describing and claiming the present invention and do not introduce any new matter. Applicants submit that in light of the arguments presented and amendments requested, this application is in condition for allowance. Accordingly, entry of these amendments, reconsideration of all pending rejections and objections, and passage to allowance is respectfully requested. With the entry of this amendment, claims 1-3, 6-7, 26, 28, 36, 38 and 48-63 are pending herein.

Amendments to the claims

Amendment of claim 1 is requested to more particularly point out and distinctly claim the present invention by providing a “a silicon nanofilm or one or more silicon nanoparticles, or a lithium alloy of said silicon nanofilm or said silicon nanoparticles, having a silicon oxide outer layer, wherein said nanofilm or nanoparticles are 18.5% to 70% SiO₂ by weight.” Support for the amendment of claim 1 is provided, for example, in paragraphs [0051] (“...nanostructured silicon material comprises up to about 70% or up to about 50% SiO₂ by weight”), [0062]-[0064] (“...the ballistically deposited sample consists of crystalline silicon and a-SiO₂ ... the ballistically consolidated silicon nanoparticles contain between 50-67% SiO₂ ... the nanofilm contained less oxygen”) and [0078] (“[i]t is likely that the large quantity of SiO₂ in the high-surface area nanocrystals is partially responsible for the reduced capacity observed”). Figures 5A and 5B [See also paragraph [0022]] provide EELS spectra showing the presence of SiO₂ in nanostructured silicon electrodes of the present invention. [See accompanying Declaration by Jason Graetz Under 37 CFR 1.132]. Support for this amendment is also

found in Figures 8A, 8C and 8E [See accompanying Declaration by Rachid Yazami Under 37 CFR 1.132] which provide voltage vs. capacity measurements for nanostructured silicon electrodes having a SiO₂ outer layer. The requested amendment of claim 1 does not introduce any new matter.

Amendment of claim 1 further provides, “wherein the thickness of the silicon nanofilm or the lithium alloy thereof is not greater than 200 nm or wherein the diameters of the silicon nanoparticles or the lithium alloy thereof are not greater than 50 nm.” Support for this amendment can be found in claims 4 and 8 as originally presented and throughout the specification, for example in paragraphs [0012] and [0044] of the application. The requested amendment of claim 1 does not introduce any new matter.

Amendments of claims 2, 6, 7, 26 and 36 are requested to provide correct antecedent basis in view of the amendment of claim 1. Support for the requested amendments is provided throughout the specification, for example in paragraphs [0011] – [012] and [015] - [016]. The request amendments of claims 2, 6, 7, 26 and 36 improve clarity and do not introduce any new matter.

Amendment of claim 38 is requested to provide a reversible specific capacity of at least 1000 mAh/g. Support for the requested amendment is provided throughout the specification, for example in paragraphs [0013] and [0017]. The requested amendment of claim 38 does not introduce any new matter.

Amendments of claims 38, 48 and 49 are requested such that these claims now depend from claim 26. Support for the requested amendments is provided throughout the specification, for example in paragraphs [0013] and [0045] and Examples 5, 6 and 7 (See, pgs, 16 – 19). The requested amendments of claims 38, 48 and 49 do not introduce any new matter.

New claims 50 - 53 are added to particularly point out and distinctly claim the present invention. Support for new claims 50 – 53 is provided throughout the specification, for example in paragraphs [0011] – [0012] of the application, and in claims 1, 5 and 8 as originally provided. New claims 50 - 53 do not add any new matter.

New claim 54 is added to more particularly point out and distinctly claim the present invention. Support for new claim 54 is provided in paragraphs [0051] and [0078] of the application. New claim 54 does not introduce any new matter.

New claim 55 is added to more particularly point out and distinctly claim the present invention. Support for new claim 55 is provided throughout the specification, for example in paragraphs [0051] and [0062]. New claim 55 does not introduce any new matter.

New claims 56 and 57 are added to more particularly point out and distinctly claim the present invention. Support for new claims 56 and 57 is provided throughout the specification, for example in paragraphs [0051], [0062]-[0063] and [0078]. New claims 56 and 57 do not introduce any new matter.

New claims 58 - 60 are added to more particularly point out and distinctly claim the present invention. Support for new claims 58 - 60 is provided throughout the specification, for example in paragraphs [0012] – [0013] and in claims 11, 12, and 13 as originally presented. New claims 58 - 60 do not introduce any new matter.

New claims 61-63 are added to more particularly point out and distinctly claim the present invention. Support for new claims 61-63 is provided throughout the specification, for example in paragraphs [0015] – [0017] and in claims 26 and 29, as originally presented. New claims 61-63 do not introduce any new matter.

Election/Restrictions

In the Office Action of December 24, 2008, claims 37 and 47 are characterized as directed to an invention that is independent or distinct from the invention as originally claimed. Applicants believe the subject matter of these claims is within the scope of Elected Species I (An electrode and electrochemical cell comprising a silicon nanofilm or a lithium alloy), as set forth in the Office Action of May 15, 2008, and therefore request reconsideration and rejoinder of these claims.

Claims 1 and 26 are identified as generic to, and thereby linking, Species I (An electrode and electrochemical cell comprising a silicon nanofilm or a lithium alloy) and Species II (An electrode and electrochemical cell comprising a silicon nanoparticle or a lithium alloy), as set forth in the Office Action of May 15, 2008. Applicants identify claims 2, 6, 7, 36, 38, 48, 49, 50, 53, 54 and 62 as corresponding to elected Species I.

Claim Objections

In the Office Action of December 24, 2008, claims 39-49 are objected to for reason of certain informalities identified for these claims. With this amendment, claims 39-47 are cancelled. Claim 48 is corrected to include the appropriate status identifier, and claims 48 and 49 are amended to depend from claim 1. Accordingly, Applicants respectfully request reconsideration and withdrawal of the pending claim objections.

Rejections under 35 U.S.C. § 112

In the Office Action of December 24, 2008, claim 41 is rejected as not further limiting the scope of claim 38 from which it depends. Applicants disagree with the Examiner's characterizations in support of this rejection.

For the sole purpose of expediting passage to issuance, however, Applicants hereby cancel claim 41 and reserve the right to pursue the subject matter of the cancelled claim in one or more continuation applications. Accordingly, withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Rejections under 35 U.S.C. § 102 and/or § 103

With entry of this Response, the present claims are amended to provide electrodes comprising a silicon nanofilm or nanoparticles, or lithium alloy thereof, having a silicon oxide outer layer having physical and electrochemical properties providing important performance benefits for secondary electrochemical cells. First, the SiO₂ outer layer contributes to the stability of the present electrodes by contributing to the formation of a solid electrolyte interphase (SEI) layer and preventing self discharge [See, accompanying Declaration by Rachid Yazami Under 37 CFR 1.132]. Second, the silicon oxide outer layer further provides important safety related benefits to secondary electrochemical cells by preventing the formation of metallic lithium dendrites [See, accompanying Declaration by Rachid Yazami Under 37 CFR 1.132]. Therefore, the claims have been amended to emphasize this important aspect of the invention and now recite “An electrode for a secondary electrochemical cell comprising a silicon nanofilm or one or more silicon nanoparticles, or a lithium alloy thereof of said silicon nanofilm or said silicon nanoparticles, having **a silicon oxide outer layer**, wherein said nanofilm or nanoparticles is **18.5% to 70% SiO₂ by weight**.”

Claims 1-3, 7, 36, 38-43, 46, 48 and 49 are rejected under 35 U.S.C. § 102(b) as being anticipated by Takamura (Abstract 257, 11th International Meeting on Lithium Batteries, 2002). Claim 7 is rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Takamura. Claims 26, 28, 44 and 45 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Takamura. Claims 6 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Takamura, in view of Sayama (Abstract 53, The 11th Meeting on Lithium Batteries, 2002).

Applicants respectfully disagree with the Examiner's characterization of the cited references and rejections under Sections 102 and 103. However, for the sole purpose of expediting passage to issuance, Applicants request amendments of the rejected

claims, as described above. Accordingly, reconsideration and withdrawal of all pending rejections under 35 U.S.C. § 102 and 35 U.S.C § 103 is respectfully requested in light of the present amendments and the following arguments.

First, the cited references, Takamura and Sayama, when taken alone or in combination, do not anticipate the present invention as these references do not disclose or teach an electrode having all the limitations of the rejected claims. Specifically, Sayama does not disclose, teach, or even suggest the presence of a SiO₂ outer layer, let alone a nanostructured silicon electrode material having an outer layer that is 18.5% to 70% SiO₂ by weight. While Takamura discloses that “inert SiO₂ formed by the presence of a residual air in the vacuum chamber,” the reference does not quantify the amount of SiO₂, let alone indicate that the electrode has **18.5% to 70% SiO₂ by weight**, as specified by the claims as amended with this response. Therefore, Applicants assert that Takamura and Sayama do not anticipate the rejected claims, as these references, taken alone or in combination, do not disclose or suggest all the limitations of the claims as amended herein [See, To Anticipate a Claim, the Reference Must Teach Every Element of the Claim, MPEP 2131; “A claim is anticipated only if each and every element as set forth in the claim is found,” *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)]. Specifically, these references do not disclose, teach or suggest an electrode or electrode chemical cell comprising “a silicon nanofilm or one or more silicon nanoparticles, or a lithium alloy of said silicon nanofilm or said silicon nanoparticles, having a silicon oxide outer layer, wherein said nanofilm or nanoparticles are 18.5% to 70% SiO₂ by weight.”

Second, Takamura and Sayama do not render obvious the rejected claims as these references, taken alone or in combination, would not motivate or enable one of ordinary skill in the art to arrive at the claimed invention, particularly a nanostructured silicon electrode material having an outer layer that is 18.5% to 70% silicon oxide by weight. The arguments presented above with regards to these references are reiterated here. Specifically, Sayama does not disclose, let alone suggest, the presence of a

silicon oxide outer layer, and Takamura does not disclose or teach an electrode having 18.5% to 70% SiO₂ by weight. Moreover, Takamura teaches that the presence of SiO₂ contributed to a significantly lowered capacity than what was estimated [See, col. 2, lines 1-6]. Therefore, the teaching in Takamura would not motivate or enable one of ordinary skill in the art to arrive at the claimed invention. Rather, this reference is fairly interpreted as teaching away from a nanostructured silicon electrode material having 18.5% to 70% SiO₂ by weight because Takamura characterizes the SiO₂ as an inert byproduct having a negative affect on the capacity of their silicon films [See the last 2 lines of col. 1 to col. 2, lines 1-6]. Applicants assert that the rejected claims are not rendered obvious by Takamura and Sayama, singularly or combined. Specifically, the disclosure of Sayama is absent any teaching or suggestion of a nanostructured silicon electrode material having a silicon oxide outer layer, let alone a nanostructured silicon electrode material having 18.5% to 70% SiO₂ by weight and this missing limitation is well outside the grasp of the skilled artisan at the time of the invention [See All Claim Limitations Must be Considered, MPEP 2143.03; “All words in a claim must be considered in judging the patentability of that claim against the prior art,” *In re Wilson*, 424 F.2d 1382 (CCPA 1970)], and the disclosure of Takamura expressly teaches against the claimed invention, specifically this reference teaches against including a silicon oxide outer layer in an electrochemical cell and especially against including an electrode having an outer layer that is 18.5% to 70% SiO₂ by weight [See Prior Art Must be Considered in its Entirety, Including Disclosures That Teach Away from the Claims, MPEP 2141.02 VI.; “A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention,” *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)].

Finally, Applicants submit that a skilled artisan at the time of the invention would have considered it undesirable to deliberately include significant amounts of a SiO₂ outer layer on a nanostructured silicon electrode material in a secondary electrochemical cell. [See accompanying Declaration by Rachid Yazami Under 37 CFR

1.132 and Exhibits discussed therein]. For example, it was well known at the time of the invention that SiO₂ contributed to irreversible loss of capacity in electrochemical cells, has a large voltage hysteresis between charge and discharge, and acts as a barrier to lithium insertion and diffusion in silicon/lithium electrochemical system. [See accompanying Declaration by Rachid Yazami Under 37 CFR 1.132 and Exhibits A and B discussed therein]. Accordingly, one of skill in the art would have been motivated at the time of the invention to minimize or entirely eliminate the presence of SiO₂ in an electrode from an electrochemical cell [See accompanying Declaration by Rachid Yazami Under 37 CFR 1.132 and Exhibits discussed therein]. Therefore, Applicants submit that the general state of the art at the time of the invention did not provide significant teaching for an electrode comprising a silicon nanofilm or lithium alloy thereof having a silicon oxide outer layer, let alone comprising a nanostructured silicon electrode having 18.5 to 70 weight % of a SiO₂ outer layer [See Predictability is Determined at the Time the Invention was Made, MPEP 2143.02 III.; “Whether an art is predictable or whether the proposed modification or combination of the prior art has a reasonable expectation of success is determined at the time the invention was made,” *Ex parte Erlich*, 2 USPQ2d 1011 (Bd. Pat. App. & Inter. 1986)].

Therefore, in view of the deficiencies in Sayama and Takamura discussed above, and considering the general state of the art at the time of the invention [See accompanying Declaration by Rachid Yazami Under 37 CFR 1.132], Applicants assert that the disclosure in these references, taken alone or in combination, do not anticipate the claims as amended herein. Furthermore, the disclosure of these references would not enable one of ordinary skill in the art to arrive at the invention as claimed. Accordingly, Applicants assert that Sayama and Takamura, taken individually or in combination, do not anticipate or render obvious the rejected claims, as these references do not disclose, teach or suggest an electrode comprising a silicon nanofilm, silicon nanoparticles or lithium alloy thereof “having a silicon oxide outer layer, wherein said nanofilm or said nanoparticles are composed of 18.5% to 70% SiO₂ by weight,” as explicitly provide by claim 1 as amended with this response. Therefore, Applicants

respectfully request reconsideration and withdrawal of the pending rejections under 35 U.S.C § 102(b) and § 103(a).

Patentability of New Claims 50-63

New claims 50-63 are added and depend from and include all the limitations of claim 1. New claims 50-63 are believed to be allowable, in view of the arguments presented above in the context of claims 1-3, 6, 7, 26, 28, 36, 38-46, 48 and 49. Accordingly, allowance and passage to issuance is respectfully requested.

CONCLUSION

In view of the foregoing, this case is considered to be in condition for allowance and passage to issuance is respectfully requested. If new issues of patentability are raised, the Examiner is invited to call and arrange for an opportunity to discuss these issues via telephone interview.

A Request for Continued Examination is being filed concurrently with this Amendment and Response to Office Action. It is believed that a corresponding fee of \$405.00 for the Request for Continued Examination and a three month extension of time and corresponding fee of \$555.00 are required for this submission. Therefore, payment in the amount of \$960.00 is being made via the EFS-Web system. If this amount is incorrect or if problems are encountered using the EFS-Web system, please deduct all appropriate fees required for this submission from Deposit Account No. 07-1969 and applicants request any extension of time required.

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